SECED

# SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

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## IN THIS ISSUE

We have a guest editorial from SECED committee member Willy Aspinall on the topical subject of the forthcoming 'Decade for Natural Hazard Reduction'.

The SECED committee have been active from the beginning in attempting to formulate a U.K. initiative in this direction without much success. It is coincidental that your editor recently wrote to the Daily Telegraph on this same theme. The letter was sent in response to remarks made by Professor John Knill at the recent British Association for the Advancement of Science conference in Sheffield. Professor Knill had made special mention of the 'Decade of Natural Hazard Reduction' and in respect of the number of deaths from natural hazards was pondering 'What British Scientists could do to reduce the toll?'.

I include the letter following Willy's editorial since it was an attempt to make a voice heard by bigger brethren. It is just unfortunate on this occasion that the Daily Telegraph was deaf.

We also have articles from Imperial College on pseudo dynamic testing along with the parallel theme of shake table testing from committee member Dr. Rodney Stubbs.

Committee member Dr. John Maquire reports upon the Euro Code 8 Seminar in Luxembourg on 6th October 1989. John has also submitted an extract from NAFEMS chairman's annual report.

Regular features appear as follows:-



The SECED Newsletter is published four times a year by the SOCIETY FOR EARTHQUAKES AND CIVIL ENGINEERING DYNAMICS and is available to all members of the society. Articles for inclusion should be sent to The Editor, SECED Newsletter, C.R.Sharman, Allott & Lomax, Fairbairn House, 23 Ashton Lane, Sale, Manchester, M33 1WP



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## Stop Press

Committee member Ed. Booth confirms that an eleven man EEFIT team will be visiting San Francisco on the 29th October following the recent earthquake. The team will consist of three SECED members plus eight representatives from industry and will stay in the U.S. for a week.

The purpose of the team will be to investigate the response of building, bridge, industrial structures and lifelines.

The team will give a briefing to E.E.F.I.T. and S.E.C.E.D. members upon their return. S.E.C.E.D are to arrange a joint meeting with Imperial College on 10th January at 4.00 p.m. (at Imperial College) for this purpose.

The Editor

## CONTENTS



The concept of a decade of international co-operation to reduce the effects of sudden natural hazards was first presented by Frank Press in the keynote address to the International Association of Earthquake Engineering at the 8th World Conference in 1984. This proposal, to dedicate the remainder of the current millennium to a concerted effort of natural hazard reduction, was universally welcomed with many approving the notion that priviledged nations, which can put men on the Moon, build Concorde or enjoy satellite television in the home, might transfer beneficial technology and expertise to less fortunate and more exposed countries.

Prodigious technical strides have been made in recent years in observing the turbulence of the natural world, so that cyclones for example should no longer arrive from over the horizon, unannounced, to devastate unprepared populations. Yet still they do. In the Caribbean, the predicted progress of each hurricane is continuously broadcast in detail. This is because they pose threats to a wealthy nation which can deploy major resources such as weather radars, (developed originally for military purposes and justified by aviation needs).

Great enthusiasm for the Decade has been engendered in Earth scientists, but this may not be entirely due to pure altruism. The predictive certainty which attends short-term weather forecasting has not yet been achieved for the other chief killers: earthquakes and volcanoes. Some scientists may view the Decade as a vehicle to facilitate prediction research on these topics, success in which would bring acclaim and personal advancement. Such motivation can prove very productive, but there is a motivation danger that genuine benefit may not accrue to those most affected. Therefore, efforts should be channelled through appropriate national and international bodies; the obvious candidate in Britain, the Royal Society, seems reluctant to assume a leading role on the scientific front.

The engineering fraternity has a long record of achievement in mitigating hazards of all kinds, but in Britain, in the wake of recent tragedies, there is an understandable pre-occupation with disasters arising directly from our own engineered environment. This was manifest in contributions to the recent inaugural meeting of the Hazards Forum, a laudable initiative (in principle) organised by the

Fellowship of Engineering. It was also clear that in some participants' minds, issues such as chartered status loomed larger than hazards reduction in faraway places. In this ambience, it may be difficult to focus partitioned institutional energies into the fairly restrictive objectives of the Decade without distraction by immediate parochial problems or enervation by internecine frictions. The Decade has been conceived to confront sudden natural disasters, not the Flixboroughs or Chernobyls of our own making.

It would be disingenuous to pretend that any contemporary British government would take a strong lead in the Decade, not withstanding potential political benefits, although some limited support may be granted under the guise of overseas aid. Aid is seldom given disinterestedly, and any provisions are usually the result of rejigging resources from other worthy causes. But politicians should recognise the growing vulnerability of friable international fiscal interdependencies. Disasters anywhere could jolt Britain's economic equilibrium: no-one can foresee the impact another great Tokyo earthquake will have on the linked economies of the world or the consequences of a cataclysmic eruption in California. With growing exposure, Lloyd's will need to be increasingly discerning about risks abroad or at home. Global warming may well produce more frequent weather extremes such that Britain itself becomes more afflicted by costly disruptions such as the great October 1987 windstorm. Doubtless government would argue that it provides the basic infrastructure for research and technological development, and specific aspirations such as the IDNDR.

The Society of Earthquake and Civil Engineering Dynamics, a small body embracing many disciplines, is the British National Section of the IAEE. It took an early interest in the IDNDR, instigating contacts with other bodies in this country; this initiative included the very successful Second Mallet - Milne Lecture held in May at the Royal Institute. The prestigious lecturer, Prof. George Housner, described the Decade, its formulation and goals. Housner identified Britain as a "resource country", which could provide much professional and academic input to such a co-operative project. It is nothing short of ignominious that the UK is not one of the more than forty countries which already have active national organizing committees.

Who, then, will provide leadership for the Decade in the UK? SECED can hardly be expected to create an influential national committee off its own bat. But the membership of the Society should make sure that its collective, rational voice is heard by its bigger brethren.

Willy Aspinall

## Letter from the Editor to the Daily Telegraph

15th September 1989

Dear Sir,

I read with interest your report of the recent British Association for the Advancement of Science conference in Sheffield and in particular the comments made by Prof. John Knill.

The proposal for the International Decade for Natural Hazard Reduction was first made by Dr. Frank Press, in a speech at the 1984 San Francisco 8th World conference on Earthquake Engineering.

Earthquakes are only one form of natural hazard and included in the 2.8 million deaths quoted by Prof. Knill are the casualties of landslides, tsunamis (tidal waves), hurricanes, tornadoes, floods, volcanic eruptions and wild fires.

In pondering what can be done to reduce this toll, the scientists can be assured that UK engineers have been actively serving to reduce the seismic hazard for some time and have been aware of the proposal for the Decade for National Hazard Reduction since its inception.

Following the 1960 2nd World Conference in Earthquake Engineering in Tokyo, the International Association for Earthquake Engineering was formed with UK representation later being provided by the Society for Earthquake and Civil Engineering Dynamics (S.E.C.E.D.). Operating under the umbrella of the Institution of Civil Engineers, the society organises informal discussions, conferences and symposia together with a biennial prestige lecture.

The biennial 'Mallet Milne' lecture carries the names of two eminent British Victorian engineering seismologists and was most recently held at the Royal Institution in May of this year. The title of the lecture was 'Coping with Natural Hazards' and was delivered by Prof. G.W. Housner a foremost American authority upon earthquake engineering and chairman of the Advisory Committee of the International Decade for Hazard Reduction.

The membership of SECED represents a significant level of UK expertise in seismic engineering comprising independent consulting engineers, commercial institutions, power authorities and universities. The work undertaken is not restricted to sophisticated commercial enterprises in the developed countries but includes assistance and research for third world nations. Lessons learnt indicate that seismic resistance of very basic structures can be significantly increased using local materials and at very little extra cost and effort.

Such research and advice often follows upon the efforts and reports of SECED's sister association E.E.F.I.T (Earthquake Engineering Field Investigation Team). This organisation has been responsible so far for sending teams of UK engineers from industry and the universities to earthquakes which include San Salvador (1986), Chile (1985) and Mexico (1985). British Universities have sent independent representatives to other events.

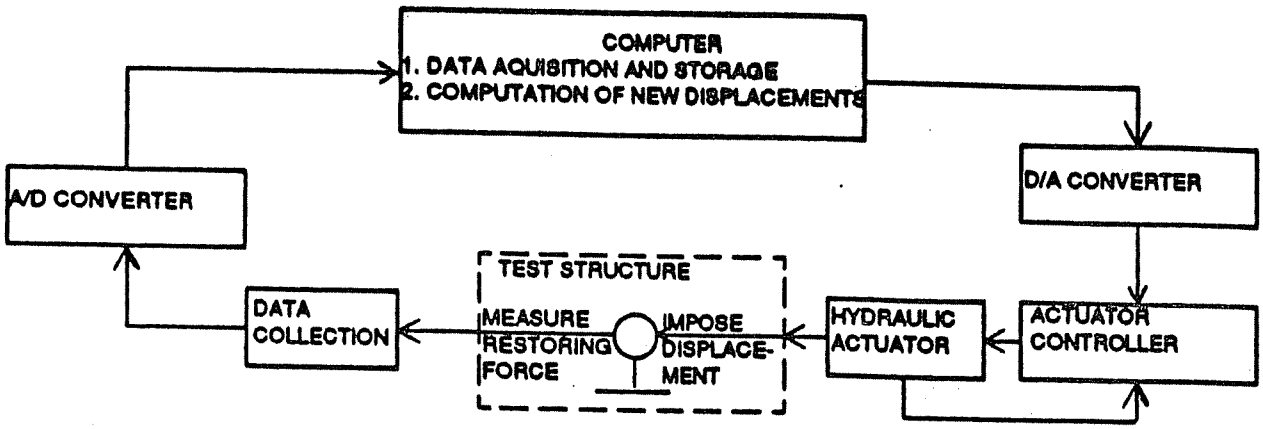
SECED has been active from the beginning in attempting to formulate an initiative toward UK participation in the Decade for Natural Hazard Reduction and we may be confident that in policies for mitigation of the seismic hazard, UK engineering has a significant contribution to make.

The recent lecture given by Prof. Housner is shortly to be published and if Prof. Knill so wishes, I would be happy to ensure he receives a copy.

C.R. Sharman
Allott & Lomax
Consulting Engineers
Manchester

## Psuedo-Dynamic Testing at Imperial College

Pseudo-dynamic testing comprises the linking of a test assembly with a computer, with the objective of conducting a dynamic test at a static rate. The dynamic equations of motion are solved on the computer using direct integration. The resulting displacements increments are applied to the structure and the reactions are measured. These forces are fed into the computer and used to solve the subsequent time step for the increments of displacements. A simplified flow-chart is shown below.




Since the limitations on specimen weight is only imposed by the capacity of the strong floor, large and full-size structures can be readily tested. Moreover, under earthquake conditions, strain-rate effects are not very significant. This technique is therefore ideally suited to testing large structures and components subjected to earthquake loading. It combines the versatility of static testing with the realism of shake-table experiments. However, shake-table testing is still needed for structures that cannot be accurately discretized, such a dams and slopes.

To compliment the existing shake-table facility, a pseudo-dynamic testing package has been assembled at Imperial College. An IBM computer is responsible for controlling the test as well as data acquisition and reduction. All digital/analog, analog/digital and filtering boards are housed in the computer, thus rendering the system very compact and easy to transport. Use is made of a set of high precision reciprocating hydraulic actuators and servo-control panels.

The first on-line test was recently conducted on a plate-bar assembly. Work is currently underway on testing of steel and steel/concrete composite columns under bending and axial force, with the aim of developing design expressions as well as realistic criteria for local buckling under earthquake loading. Future developments will include improved time integration techniques, fast-rate testing and sub-structuring procedures.

For further information, contact: Amr Elnashai, Civil Engineering Department, Imperial College, London SW7 2BU.

## The Large Scale High Performance Shake Table Facility in Japan

This article describes the shaker table facility operated by the Nuclear Power Engineering Test Centre at its Tadotsu Engineering Laboratory on Shikoku Island in Southern Japan.

The worlds largest seismic shaker table facility and its dedicated engineering laboratory was completed in the Summer of 1982 after six years of construction. The table surface is of 15m square and 3.5m thick, it is of a welded steel construction. Its maximum load capability is 1000 tonne which can be excited biaxially (V x H). The maximum horizontal and vertical acceleration at full load is 1.84g and 0.92g respectively, with a 500 tonne load this increases to 2.7g and 1.4g respectively. It has a max horizontal and vertical displacement of +/- 20cm and +/- 10cm respectively. The frequency range is 0 - 30 Hz and duration of shaking is 20 sec at full load.

In order to isolate the structure from its surroundings the basemat was built 45m X 90m X 10m average thickness, the maximum thickness rising to 21m. The whole facility is housed in a building of more than 4000 sq m floor area, with an overhead crane capacity of 500 tonne.

Beside the main building is the control and data collection building. This has an air cushioned anti-vibration floor to protect the electronic equipment from vibration. The table is fully computer controlled and the data collection system allows more than 300 lines of data to be recorded

simultaneously. Mainframe computer facilities allow high level data analysis to be carried out on site.

On the other side of the main building from the control room is the hydraulic power house, which so as to reduce the size of the hydraulic pumps, (50MW capacity would be necessary if the table was directly driven from the electrical grid), houses a series of high pressure accumulators. To aid the transportation of large components for testing the facility is built on the sea shore.

The purpose of this magnificent laboratory is to seismically qualify large nuclear power plant components, and to test and confirm the seismic safety of large scale models. One aspect of this latter purpose is the validation of computer models. Colaborative work with the United States Nuclear Regulatory Commission and other foreign organizations has also been undertaken.

During the commissioning phase of the facility the opportunity was taken to perform soil structure interaction tests, using the table as the vibration source.

To give an example of the type of tests that have been performed a 1:1 scale model of a Pressurized Water Reactor (PWR) core and internals was tested for control rod insertion capability during seismic excitation. In this model the reactor core with dummy fuel elements was in a modelled reactor pressure vessel. The whole being about 18m high and weighing about 450 tonne with water in the pressure vessel. This model was tested to 0.74g peak horizontal acceleration and the control rod assemblies shown to be capable of inserting during the simulated earthquake within the time required in the reactors technical specification.

A second example is a 1:3.7 scale model of PWR steel containment building weighing about 340 tonne. It was complete with personnel and equipment hatches and had a model polar crane inside. It was pressurized, and tested to 50% above the design level acceleration for 40 sec duration. It was found not only to respond basically as modelled, but also to retain leak tightness under such extreme conditions.

Apart from being able to qualify large components, one of the advantages claimed for such a facility is that the scaling problems so often associated with computer model validation are either non existant or small, therefore giving a much greater confidence in validation process.

The author when he visited the facility and discussed their work with the operators was impressed not only with capability of the facility, but also with the immaculate condition of the equipment. This even extended to the hydraulic rams beneath the table and to the accumulators and pumping room. Despite the laboratory have been operating for several years there were no oil leaks or sign of leaks to be seen anywhere.

A large proportion of the work performed has been published and presented at conferences. The SMIRT series of conferences being a good example. The results have given and are giving greater confidence both in the safety of nuclear power generating facility components as well as in the capability to accurately model their behavious under seismic loads.

Dr. Rodney Stubbs
19/7/89

## Euro Code 8 Seminar in Luxembourg - 6th October 1989

A number of British engineers recently attended a C.E.C seminar organised by Prof. Sedlacek of R.W.T.H. Aachen. Those present included Haig Gulvanessian (B.R.E.), Amer Elnashi (Imperial

College), David Smith (Scott Wilson Kirkpatrick), John Maguire (Lloyds Register), Malcolm Goodwin (B.E.Q.E.) and Satish Desai (D.O.E).

The purpose of the seminar was to give more information about Euro Code 8 (in the form of presentations, design examples and background information) and to request further comments upon the latest draft (May 1988).

The one day seminar was split up into a number of short introductory sessions covering:-

- Technical regulations in building and civil engineering;
- General presentation of Euro Code 8 (May 1988 draft);
- Requirements and methods;
- Seismic actions;
- Reinforced concrete buildings;
- Steel and composite buildings;
- Masonry buildings;
- Timber structures;
- Non structural elements;
- Current developments for further EC8 applications.

The timetable for Euro Code 8 now seems to be as follows:-

(i) Autumn 1989
- Draft EC8 (May 88) published in six languages;
- Seminars held in Luxembourg, Lisbon, Rome and Athens;
- Comments invited;

(ii) Sometime 1990
- Transfer of EC8 work to CEN (CEN to bring in EFTA contributions as well as EC);

(iii) Sometime 1990
- CEN issue EC8 in the form of a European pre standard (ENV);

(iv) Unknown date
- Period for experimental use;

(v) Unknown date
- CEN prepares a revised ENV and issues as a European Standard (EN)

Copies of Euro Code 8 Structures in Seismic Regions - Design - Part 1 - General and Building, May 1988 Ed. may be obtained through the office for official publications of the European Communities in Luxembourg for ECU 30

Copies of the seminar Presentations and Design Examples have been given to seminar participants but do not seem to be generally available.
The report reference is "Report in Reference to Euro Code 8 - EVR 12266" and is published on behalf of the C.E.C., Directorate DG III/8077/89 EN.

In conclusion, a helpful seminar with a particularly useful set of design examples provided.

There were 82 participants in all, 33 from Germany, 29 from France, 6 from the UK, 5 from Belgium, 2 each from Greece, Italy and Netherlands and 1 each from Portugal, Denmark and Luxembourg

J.R. Maguire
6/10/89

## NAFEMS Annual General Meeting 1989 - Extract from Chairman's Report

### NAFEMS and NEL Privatisation

The uncertain future of the National Engineering Laboratory has been clarified: it is to become a "next steps agency", which means that it is to remain within the Department of Trade and Industry while it is restructured to achieve commercial viability for future privatisation. As reported last year, we do not consider it appropriate for NAFEMS, as a national standards setting body, to be owned and run as a commercial project in a company operating primarily for profit. The Steering Committee consider that it is necessary to take steps to ensure the independence and impartiality of NAFEMS and discussions are taking place with DTI to realise these aims. The proposal currently under discussion is to set up a new Council as the policy-making body of NAFEMS and as the nucleus of an independent, non-profit making organisation to take over ownership on behalf of the members when that becomes appropriate. The Council would comprise appointees from DTI, as the major financial contributor and interim owner and independent members, not all necessarily from the specialist FE community, but including prominent representatives of that community; the Steering Committee chairman will be an ex officio member. This would represent a major change from the present, where NAFEMS is wholly owned, controlled and funded by NEL and the agreement and co-operation of the Laboratory are essential; special transition arrangments would be required. We are confident that this structure would offer a viable basis for continuity and independence of our Agency. The changes proposed for NAFEMS coincide with changes in DTI funding arrangements which will increase pressure to improve our financial viability; we are seeking continuation of substantial government support, both as an indicator of our official standing and as an activity which in our view fully deserves National funding.

## SECED MEETINGS

The report upon the recent meeting dealing with the Spitak - Armenia Earthquake will appear in the next issue of the Newsletter.

For the next quarter, members should have been circulated with details of Integrity Monitoring at Heriot -Watt University on 25th October.

We also have our meeting on NAFEMS Dynamic Benchmarks on 22nd November at the Institute of Civil Engineers at 5.30pm.

We are also hoping to arrange co-sponsorship with the Lancashire and Cheshire branch of the Institution of Structual Engineers who are to hold a meeting on "Design Criteria for Nuclear Plant" at Risley, Warrington on Tuesday 16th January 1990. Further details will be announced in our next Newsletter or through the secretariat. Watch for details.

## CONFERENCE CALENDAR

| TITLE | DATE | LOCATION | ORGANISER |
|---|---|---|---|
| Structures - Today and beyond 2000 | 9-11 May 1990 | Glasgow | I. Struct E |

| | | | |
|---|---|---|---|
| European Conference on Structural Dynamics (EURODYN 90) | 5-7 June 1990 | Germany | Ruhr - Universitat Bochum |
| International Conference on Vibration Problems in Engineering | 6-9 June 1990 | China | Chinese Soc for Vibration Engineering |
| 9th European Conference on Earthquake Engineering | Sept 1990 | Moscow | Soviet Comm. on Earthquake Engineering |
| 2nd International on recent advances Geotechnical Earthquake Engineering and Soil Dynamics | 11-15 March 1991 | St. Louis USA | University of Missouri - in Rolla |
| Measurement and Effects of Vibration (3rd SECED Conference) | Spring 1992 | To be announced | SECED |

## PUBLICATIONS

(*SECED and related)

1. *"Directory of Practitioners in Earthquake Engineering and Civil Engineering Dynamics" (Issue No.2, April 1988)
Price: £15.00 (Summer 1988) from Chris Sharman, Allott and Lomax.

2. *"Earthquakes & Earthquake Engineering in Britain"
(1st SECED Conference, 18-19 April 1985, University of East Anglia)
Price: £30.00 (Spring 1988) from Thomas Telford Limited.

3. *"Civil Engineering Dynamics"
(2nd SECED Conference, 24-25 March 1988, University of Bristol)
Price: £30.00-pub. Due Autumn 1989 from Thomas Telford Limited.

4. *"The Mexican Earthquake of 19 September 1985"
(A field report by EEFIT)
PRICE: £25.00 (Autumn 1988) from Thomas Telford Limited.

5. *"The San Salvador Earthquake of 10th October 1986"
(A field report by EEFIT)
Price: £10.00 (1987) from RPT or Julian Bommer, Imperial College.

6. *"The Chilean Earthquake of 3rd March 1985"
(A field report by EEFIT)
£25.00 (Autumn 1988) from Thomas Telford.

7. *"EEFIT Constitution and Aims and Methods" booklet
Price: Free Order from Secretary, SECED.

8. "Earthquake Design Practice for Buildings"
(ICE Design Series - author David E. Key)
Price: £35.00 (Spring 1988) from Thamas Telford Limited.

9. "Dams and Earthquake"
(A conference held at the ICE 1-2 October 1980)
Price: £35.00 (Spring 1988) from Thomas Telford Limited.

10. "Earthquakes" (Bibliography 87/1)
(Books, pamphlets & serial publications of interest to earthquake engineers)
Price: £8.00 (Spring 1988, to ICE members) from Thomas Telford Limited.

11. *1987 Mallet-Milne Lecture
'Engineering Seismology' by N.N. Ambraseys. Volume 17 of Earthquake Engineering and Structual Dynamics (Special Issue). Price £15.00 (Earthquake Engineering Subscribers, IAEE members, ICE members) £25.00 Institutions, £15.00 Personal. Send order to Dept. AC, John Wiley & Sons Ltd., Baffins Lane, Chichester.

12. *1989 Mallet-Milne Lecture
'Coping with Natural Disasters' by G.W. Housner - Price £10.50 to personal callers at Telford International Bookshop, ICE or direct from The Secretary, SECED, Institute of Civil Engineers, 25, Eccleston Square, London, SW1V 1NX. (Cheques payable to "Institution of Civil Engineers". Post free UK, plus 50P Europe, plus £1-00 elsewhere).

## MEMBERSHIP NOTES

### Committee 1988-89

### Elected Members

Dr. W.P. Aspinall - Mass Data Systems

Dr. C. W. A. Browitt - British Geological Survey

Dr. J. R. Maguire - Lloyds Register

Dr. P. Merriman - BNFL

C. R. Sharman - Allott and Lomax

Dr. R. J. Stubbs - Health & Safety Executive

### Representatives

### Institute of Civil Engineers

Professor H.A. Buchholdt - Polytechnic of Central London